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# RETHINKING "SYSTEMS" IN INFORMATION SYSTEMS (SYSTEMATICALLY)

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# RETHINKING “SYSTEMS” IN INFORMATION SYSTEMS (SYSTEMATICALLY)

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## Abstract

*This paper argues that the information systems (IS) field needs to widen its focus in three directions: from the systems development life cycle to the full systems life cycle, from information systems to business systems, and, most fundamentally, from Type I information work (clerical) to Type II information work (the work of line managers, staff managers, and professionals). This expanded vision will require new research and teaching methods. Most fundamentally, we need to embrace exploratory descriptive research in order to understand these areas before we can do effective theory-based empirical research.*

*Keywords: Information systems, Management information systems, Office work, Descriptive research, Systems development life cycle, Systems life cycle, Type I information work, Type II information work, information support work, knowledge work, use and user (U2) studies*

## 1. Introduction

As an academic discipline in business schools, information systems (IS) was born in the 1960s and 1970s. This was the Great Age of Systems Thinking in universities. Graduate students across a broad spectrum of disciplines read such systems theorists as Berrien (1968), Bertalanffy (1968), Churchman (1968), and Klir (1969). The key insight of Systems Theory is that technology in complex situations needs human and institutional elements to be successful. Perhaps the earliest textbook in the IT field was *Management Information Systems: Text and Cases*, published in 1966 (Dearden and McFarland). The term *management information systems* eventually gave way to *information systems*. We still use that name to denote our discipline today.

While our discipline’s focus on systems is certainly appropriate, this paper argues that our initial experience with information systems in corporations has limited our subsequent thinking about IT-related systems in corporations.

In its earliest days, IS was roughly synonymous with clerical transaction processing systems. This was not because transaction processing was the largest and most important aspect of corporate information. As Figure 1 shows, most corporations have far fewer clerical workers than line managers, staff managers, and professionals. This is not just a recent development. It has been true since the beginning of the last century (U.S. Bureau of the Census, 1973).

Office Occupational Category	Employment (thousands)	Percent of Information Employment	Percent of Total Employment
Management Specialists (line managers)	6,023	10%	5%
Business and Financial Operations Specialists (staff managers)	6,091	10%	5%
Professionals	27,071	45%	21%
Subtotal, Managers and Professionals	39,185	65%	31%
Office and Administrative Support	21,504	35%	17%

Total Information Workers	60,689	100%
Total Employment	127,097	100%

Figure 1: U.S. Office Employment, May 2010. Source: Bureau of Labor Statistics.

Rather, we began with transaction processing because initial computers and programming languages were so limited that we could only computerize actions that were extremely well-defined and relatively simple. In addition, to be computerized economically, these had to be actions that were executed over and over. Only transaction processing procedures fit these early requirements. As technology advanced, the information from transaction processing system was made available to management. This was the birth of management information systems. Ever since, we have tended to focus on transaction processing and MIS in our business school courses; we have taught programming, systems analysis and design, and database management systems as the core of our programs. When we talked about management information systems and later business intelligence, we focused heavily on data from central transaction processing databases and the needs of line managers regarding this data.

However, even in the 1960s, transaction processing and management spin-offs were only a part of information systems in corporations. In high-technology companies, many engineers began to write their own programs in the late 1960s. (In 1964, the author, in his first university term, had a required course on using slide rules and took a non-required course in FORTRAN programming.) Computers began to be used in many other parts of the firm, but the information systems department often played a peripheral role in these aspects of IT. In the 1970s, end user computing spread beyond engineering and scientific departments and began to be used widely in departments that dealt only peripherally with transaction processing-based information. End user computing has become enormously large, complex, and varied (Panko and Port, 2012). However, IS programs and corporate IT department still focus heavily on corporate databases and line managers.

This paper argues that if our field is to advance, we need to look in three major directions that we have previously slighted. This paper argues that if we do, we may be able to revitalize our field and make our work far more relevant to our students and to corporations in general. Figure 2 gives an overview of our expanded vision for information systems.

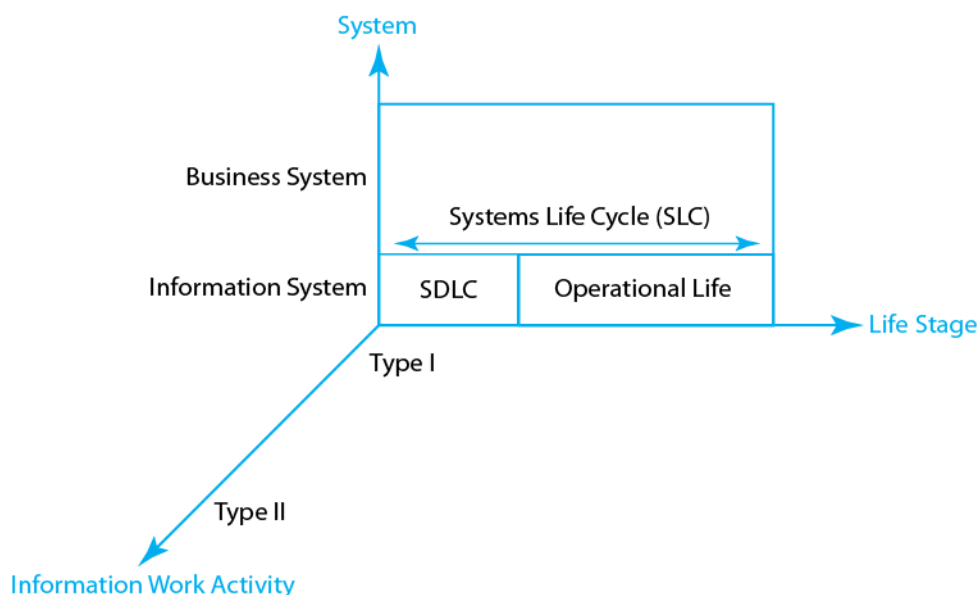


Figure 2: Directions for an Expanded Vision for Information Systems

First, the paper argues that we need to go beyond the systems development life cycle (SDLC) to the full *systems life cycle (SLC)*. In our major courses, the focus has long been on the SDLC. The operational phase of the Systems Life Cycle (SLC) has been largely ignored outside of occasional discussions of maintenance activities and the activities of IT help desk units. This made sense in applications for which programming or purchasing applications and then installing them was the most critical activity. However, it makes absolutely no sense for networking, security, and many other aspects of corporate information systems. Fundamentally, training only our IS majors about the SDLC is like only training doctors in obstetrics and ignoring medical needs after birth.

In addition, even if focusing on the SDLC once made sense for corporate IT departments, it never made sense for users, who must live with operational information systems and figure out how to use IT to improve personal and corporate performance. Improving performance is difficult to do, and the “MIS courses” we require all students to take do little to help them in this challenging task.

Second, we need to broaden our focus from information systems to the broader *business systems* in which our “information systems” are embedded. Our vision of business unit systems is very stunted, and among other things, it has caused us to cede the information systems auditing and governance fields to Accounting departments in business schools. Information systems mean nothing if they do not improve the business systems in which they are embedded. Simply dropping an information system into a business system and expecting improvement is naïve. We need to understand how organizations work to a much deeper degree than we do now if we are to be effective and relevant. Our stunted understanding of what goes on in real corporations and how this relates to IT needs to be completely reworked.

Third, and we argue most importantly, our broader understanding of corporations must embrace something like the distinction between Type I and Type II information work activities suggested by Panko and Sprague (Panko, 1982 1988; Panko and Sprague, 1982). In this dichotomy, clerical transaction processing units such as accounting, payroll, and inventory are Type I units, signifying that they were the first type of office supported with technology. However, we will see that most information work in the firm is Type II work, done primarily by line managers, staff managers, and professionals—who far outnumber clerical workers in firms (Panko and Port, 2012). This paper argues that the things we are teaching our IS majors were extremely appropriate for Type I information work but are completely inadequate for the Type II information work that dominates information work in the organization.

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*Type I information work units (clerical) were the first type of office we supported. Type II information work units (staffed by line managers, staff managers, and professionals) are the information work units we need to support today.*

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## 2. From the SDLC to the SLC

We will begin with the simplest part of Figure 2, the need to extend our focus from the systems development life cycle to the systems life cycle. Few would argue that operational life after development is far longer than the systems development stage. Few would also argue that the operational use stage is what brings payoffs from information systems. Yet in schools, we focus on the SDLC. The reason appears to be that in clerical transaction processing, the corporate IT department’s major role has been limited to the systems development phase and occasional maintenance episodes afterward.

However, when you look even at information systems department work, a great deal of work goes into supporting the operational life of systems. In networking, design and project management for changes is important, but much of the total work comes in the day to day management of the network. In addition, the operational life in networking is extremely complex and requires strong skills. In security, by far the largest amount of effort comes during operational life. Security staffs constantly need to fend off attacks, revise access control lists and intrusion detection rules, clean up after compromises, and so forth.

Unfortunately, in universities, our networking and security textbooks and courses rarely go beyond mentioning the skills needed in networking as security.

Increasing our teaching and research focus on operational life beyond the SDLC promises to be a “target-rich environment.” Training is an obvious issue, but it is only one. We need to understand the complex ways in which people adapt the information systems we create to meet their needs. We need to understand the types of errors that people make when they use technology to do their work. We need to understand how to implement security in ways that make sense given the way real people work. We need to understand how exceptions are handled, and we need to understand the shadow systems that people often create to help them deal with the limits of the information systems we create. We need to understand how information produces benefits, especially in less-defined office activities. We need to understand ongoing governance and auditing. We need to understand what networking professionals, database professionals, other IT professionals do in the operational lives of our systems. Most fundamentally, we need to understand the work done by information support and knowledge workers in a flesh-and-blood way.

### 3. Beyond Information Systems

A second arrow in Figure 2 suggests that we need to expand our vision of IS beyond our technical information systems, into the broader world of corporate activities in information work units. (We do not consider manufacturing, service, and other non-information activities in this paper, despite the fact that they use information systems.) If we are to support strategic planning processes, new product development, marketing, and the many other complex information work units in corporations, we need to understand them.

Unfortunately, our understanding of work in corporations is very limited. In marketing, it is said that “the consumer is the familiar unknown.” We deal with them constantly but really do not understand them. For example, in IS, we often depict organizations as pyramids with three layers. At the top are executives, in the middle are middle managers, and at the bottom are operational managers managing, well, something. In contrast, management has a far richer view of organizations. For example, Figure 3 shows Mintzberg’s (1979) model of organizations, which was based on a dozen studies. It also shows an executive group at the top and an operational core at the bottom. However, instead of showing a wide swath of middle line managers, it shows a relatively small central line of middle line managers. It then shows large support and control “blobs” on the two sides of the middle line managers. Many of the people who work in these blobs are professionals in established professions such as engineering. Many others are staff managers, who work in offices that do professional work but in which there is no classically defined professions.

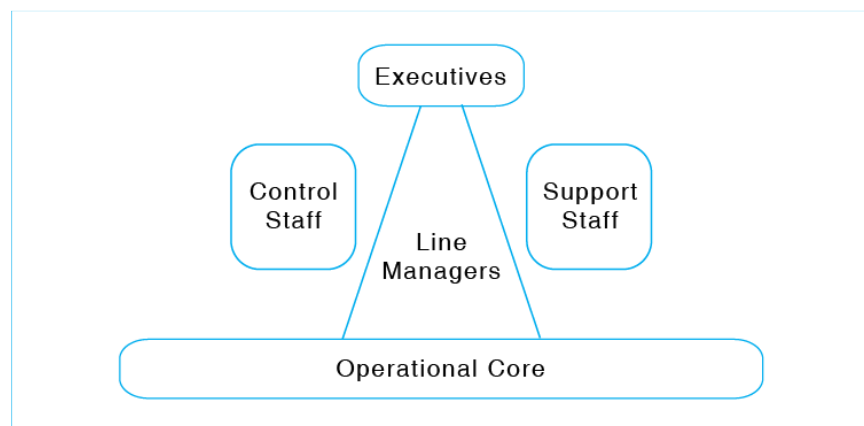


Figure 3: *Mintzberg's Model of Organizations*

The data in Figure 1 support the Mintzberg model. Managers in total only make up ten percent of overall employment. In addition, Knowledge workers in business and financial operations, who correspond roughly to staff managers, are as numerous as managers. Professionals, who are staff managers in some firms and core workers in others (such as education and health service), are even more numerous.

In addition, IS's vision of managers typically involves their looking at output from MIS reports, decision support systems, executive information systems, and other aspects of business intelligence. This is completely at odds with use of time studies that examined what executives, line managers, staff managers, and professionals really do. Figure 4 gives a summary of results of such studies. Unfortunately, none have been done since the days of ubiquitous computing, but they show that managers spend most of their days communicating. Even professionals spend much of their days communicating. How much of this communication involves central corporate data? We really have no idea, but detailed studies of meetings question whether it is very much.

Interaction Category	Managers	Executives	Other Knowledge Workers
Oral (spoken) Communication (Total)	60%	75%	35%
Face-to-face meetings	55%	70%	25%
Dyadic (2-person)	25%	NM	NM
Conference room	NM	NM	NM
Telephone	5%	NM	NM
Written Communication	25%	NM	25%
Total Communication	85%	NM	60%

Figure 4: Summary of Use of Time Studies. Source: Panko (1992)  
 NM = not measured well.

Despite the obvious importance of communication, and despite the complexity of organizational communication that has been shown in empirical research on what managers and other knowledge workers really do, we have done little to understand how our communication tools are used to produce value in office. What other aspects of information technology in information and knowledge work are we missing?

#### 4. Type I and Type II Information Activities

The diversity of information work in organizations is enormous. However, Panko and Sprague (Panko, 1982 1988; Panko and Sprague, 1982) have argued that that it is helpful to understand non-transaction processing office activities in terms of a fundamental distinction between Type I and Type II information work activities. As noted earlier, these two types of activities received these titles because Type I information activities were the first type to be supported by information technology (transaction processing activities). Type II information activities represent the opposite extreme. Most real office activities are somewhere between these two extremes in terms of characteristics. However, we need to examine the Type II extreme to understand why our general view of information systems needs to be expanded.

## 4.1 Characteristics of Type I and Type II Office Activities

Figure 5 shows basic differences between Type I and Type II information work activities. Most fundamentally, in Type I information activities, the work is mostly routine and clerical. In Type II information activities, in contrast, the work is mostly nonroutine managerial and professional work. We can use the more general term, knowledge work.

Category	Type I Information Activities	Type II Information Activities
Defining Differences		
Historical order of support	Initial (Hence the designation)	Later (Hence the designation)
Primary Nature of Work	Mostly routine clerical work	Mostly nonroutine managerial and professional work (Knowledge work)
Focus of activities	Procedures	Strategies, processes, and goals
Typical Workers	Clerical	Line managers, staff managers, professionals
Typical Departments	Accounting, billing, inventory	Engineering, marketing, corporate relations, finance
Typical Cross-company workflows	Enterprise resource planning (ERP)	New product development, cross-department projects
Typical Corporations	Manufacturing, food service	Education, medicine, architecture
Importance		
Employment today	Small	Large
Employment before computers	Small	Large
Criticality to the firm	Modest	Critical

Figure 5: *Characteristics of Type I and Type II Information Work Activities.*

In traditional Type I activities, work is highly structured by procedures. In Type II activities, in contrast, the focus is more on strategies, processes, and goals. We define processes as repeated activities that are somewhat structured by not reduced to well-defined procedures.

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In an early study, the author and his students interviewed many workers in 57 Type II work units. Although the subjects could identify some simple procedures in their work, they viewed these as infrequent and unimportant. However, they were extremely articulate about broad processes, strategies, and goals to be met creatively.

Type I department employment is dominated by clerical workers, but there will certainly be managers, and there may be professionals. Type II department employment, in contrast, is dominated by line managers, staff managers, and professionals. There will be some clerical workers too, of course, such as clerical assistants or secretaries. However, the distinction between Type I and Type 2 departments still makes sense and is important.

The Type distinction can be applied at several levels of the organization.

- We have just seen the difference between Type I and Type II information workers.
- These workers, furthermore, will have both Type I and Type II activities in their daily work.

- At the department level, there are Type I departments such as accounting, payroll, and billing, and Type II departments such as engineering, marketing, corporate relations, and finance.
- At the cross-department level, there are Type I transactions processing flows, such as those in ERP. An example of a Type II information work activity that spans departments in organizations is new product development. In addition, nearly all managers and professionals engage in cross-department project teams.
- There are even Type I companies and industries such as insurance and Type II companies and industries such as education, medicine, and architecture. In U.S. Bureau of Labor Statistics data, the largest “industry” is Government, and the second is Health and Education. The third is Professional Services. Continuing to teach manufacturing firms as examples in classes is really an admission that we do not understand how Type II industries work. Nor will focusing on non-manufacturing Type I service industries.

As noted, there are many more line managers, staff managers, and professionals than there are clerical workers. There is plausibly far more employment in Type I activities than in Type II business activities as well. In addition, it would be difficult to argue that clerical work is more important than the work of line managers, staff managers, and professionals. Type II information work activities, not Type I information work activities, are the critical information activities in organizations.

## 4.2 Considerations for IT Support

If the distinction between Type I and Type II information work made no difference to corporate information systems departments, then the distinction would be unimportant. However, as Figure 6 shows, the difference is fundamental to IS support.

Considerations for IT Support		
Category	Type I Information Work Activities	Type II Information Work Activities
Work focus	Procedures	Processes, Nonrepetitive Work
Procedures exist and are central	Yes, Yes	Yes, No
Work definition	Well-defined	Loosely defined
Repetition, volume	High, High	Low, Low
Centrality of database data	Yes	No
Systems analysis methodology	Well understood	Poorly explored
Support	Automation	Augmentation
Locus of Control	IT	Business units
Role of IT	Information system development and management	Support, needs analysis, assistance in governance
Role of IS Education	Training IT professionals	Training IT professionals; training line managers, staff managers, and professionals.

Figure 6: *Considerations for IT Support*

First, work in Type I activities is dominated by well-defined repetitive procedures such as taking customer orders. Our systems analysis methodologies focus on these procedures and the data they generate and require. In Type II information activities, however, work mostly has processes instead of procedures. As just noted, processes are repetitive activities but are not reduced to procedures. There are general actions to be taken, and there is general sequencing, but new product development cannot be reduced to well-defined procedures. Many traditional systems analysis approaches focus on procedures and do not collect detailed information about the ways that Type II workers and work units use technology to achieve their goals.



Although procedures exist in Type II information activities, they are not central. The study of 57 offices mentioned earlier found that while knowledge workers could identify some procedures, these procedures were of minor importance. In most cases, there were processes. These were far more important. However, they were not sufficiently well-defined to be analyzed by traditional systems analysis methodologies.

Even more importantly, much of the work in Type II information work is non-repetitive or at most occasional. Line managers, staff managers, and professionals constantly have to deal with new situations that often required new thinking. Traditional systems analysis is not ideal for these types of activities.

In these 57 departments, corporate database information was only extremely important in three. This was certainly no random sample, but we need to understand what information is actually used in Type II business functions. Just because the central IT department revolves around central database systems, this does not mean that most work units in the corporation do.

Engelbart (1962) distinguished between automation and augmentation. In automation, a human process is heavily replaced by a computer process. In augmentation, the person's ability to solve intellectual problems is expanded. Engelbart used a counterexample, noting what would happen if a writer had a pencil with a brick tied to its end. The writing process would be de-augmented. Augmentation, unfortunately, is more difficult to comprehend, yet it is far more important to understand.

Another consideration in IT support is the locus of control in IS projects. In Type I work units, the locus of IS control is the IT department. In Type II work units, business units and individuals control how technology is used and integrated into work. At the same time, Type II units would probably welcome suggestions for support, needs analysis, assistance in governance, and other matters that IS department typically do not provide today.

### 4.3 Challenges for Management

Probably the most profound question in understanding how to provide IS support to Type II information activities is understanding how to *manage* activities in Type II information work. Figure 7 lists major challenges for understanding management in Type I and Type II units.

Challenges for Understanding Management		
Category	Type I Information Activities	Type II Information Activities
Focus	How to do things	What to do
Criteria	Efficiency / productivity and quality	Effectiveness / goal attainment
Criteria for success	Simple	Complex
Critical knowledge	Task	Domain, human
Discretion	Low	High
Oversight	Direct	Envelope supervision
Supervision	Rules	Goals, Policies
Adoption	Mandatory	Discretionary
Adoption	Faithful adoption	Adaptation
Pace of change	Slow	Fast
Time focus	Short term	Long term

Figure 7: Challenges for Work Management

In Type I information activities, management is relatively clear. The focus is on understanding how to do things more efficiently, and with better quality. Criteria for success usually are relatively simple to understand (such as promptness and accuracy), and one can manage primarily by focusing on the specific tasks that employees do. Discretion is low, and oversight is direct. In the terminology of Poole and

DeSanctis (1992), adoption should be “faithful” to the spirit of the technology if it is to have its highest impact. In other words, workers should use the technology as it was *meant* to be used.

Type II information activities are the opposite in terms of management. Management must focus on the more subtle question of what to do, and management must determine how to increase effectiveness and attain goals. Knowledge workers in Type II information activities must be given considerable discretion in both what they do and how they do it. Instead of adopting technologies, they adapt it to meet their requirements, often using it in entirely different than what its creators thought was best.

In Type I information work, the focus is on short-term activities, and the pace of change is slow. Almost paradoxically, the pace of change in Type II activities is very fast, yet there must be a strong focus on the long term when decisions are made.

Overall, the characteristics of Type I information activities make them (relatively) easily to understand, support with technology, and manage effectively. However, nearly every lesson we have learned about managing Type I office activities may have little value in Type II information activities.

Worse yet, these lessons may actually be counterproductive. Benveniste (1987) has written extensively about the problems that occur when we try to supervise professionals the way we supervise clerical workers. If we continue to fail to understand the need for very different management, our information technology may be doing harm instead of improving organizational work.

Our understanding of how Type II activities work in organizations is likely to give us some complex understanding of how work is organized and managed. Figure 8 shows some of the elements that may have to be considered. The reader will probably be able to add a few more complications.

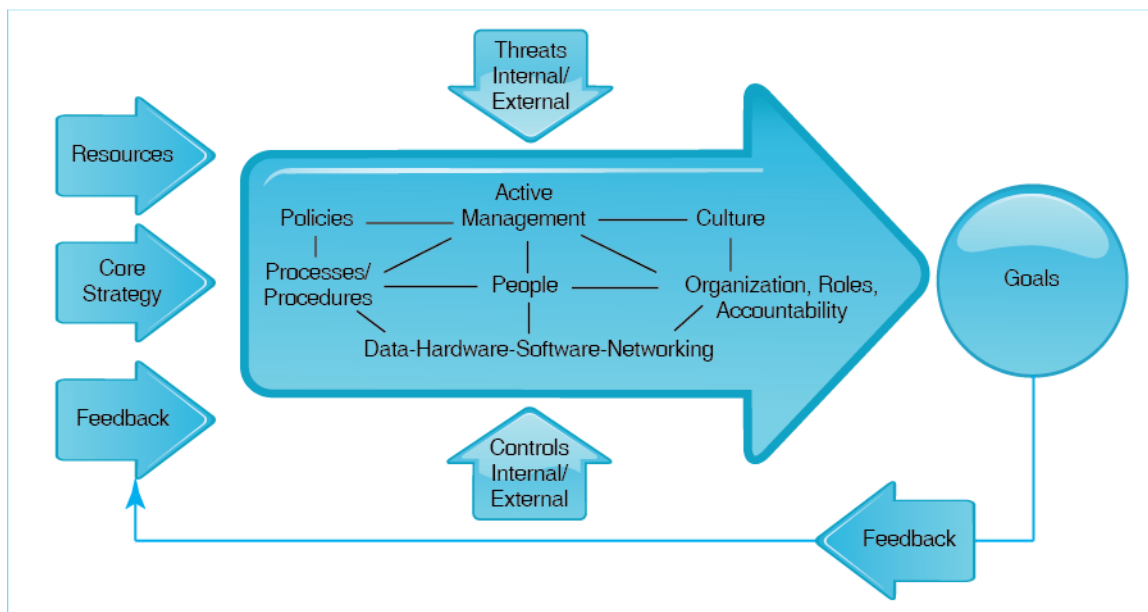


Figure 8: Organizational System Components

## 5. Conclusion: Use and User (U2) Studies

In this paper, we have laid out three directions in which we should be advancing our field.

- We need to expand our focus from the systems development life cycle (SDLC) to the systems life cycle (SLC) to deal with the demands of IT concerns such as networking and security and to improve benefits in the very long period that corporations use our technical systems.

- We also need to expand our focus from narrow information systems to broader organizational systems that use our technology. Unless we understand how information technology can improve those broader systems, our role will continue to be limited.
- Underlying the first two directions, we need to realize that information technology support has matured from supporting Type I information work activities to supporting Type II information activities. Yet we still continue to focus on tools and systems approaches that were born when only Type I activities existed, that are ineffective in Type II systems, and are even likely to be damaging.

Throughout this paper, we have tried to give some examples of what it may be like to move in those directions. However, the reality is that the ground in these three directions is largely *terra incognita*. At this point, we can only begin exploring them.

In new areas, it is important to do *exploratory descriptive research*. Some of this can be done using government databases, particularly employment databases. However, we need to actually go into organizations to understand how they are really structured, so that we can get rid of simplistic pyramids and even somewhat more informed models like those of Mintzberg (1979). We need to watch employees in Type II employees and activities as they work, in order to understand how we might be able to support them in a way better than tossing spreadsheet technologies, e-mail, and other tools “over the wall” to them.

In addition, we need to look beyond the kinds of research that would help our reference discipline in organizations and look at ways to help the far more numerous people who work in Type II business units use technology better. This is a radical idea, but if we want our academic discipline to really matter to business, then we need to look beyond the concerns of the IT department. Or perhaps we will change the way the IT department views itself in a fundamental way. We must focus on doing *use and user (U2) studies* that shed light on the reality of IT use in corporations.

A serious methodological problem is that before we can develop theory, we need to have a large base of descriptive understandings about work in Type II information work. However, the IS discipline is rarely kind to people doing descriptive research. “Dust-dry empiricism” is a common epitaph for descriptive research. Among academic publications, descriptive research is often referred to derisively as “the D word.” Or, it is sometimes tolerated if it at least creates a theory using something like grounded theory development. Doing descriptive research simply to get a better empirical understanding of details and broad patterns is rarely considered good research.

In this respect, our field is unusual. In the author’s first academic field, physics, there is a fruitful interplay between empirical research and theoretical research. Many people misunderstand the importance of empirical physics, thinking that its purpose is to test specific theories. While testing theories is important, empiricism in physics is really fruitful when it creates completely unexpected results. As Richard Feynman once noted, experimentalists are really happy when they look at the data and say, “Huh, that’s odd.” As Frederic Joliet-Curie put it, “The farther the experiment is from theory, the closer it is to the Nobel Prize.” As accelerators get ever higher power, they take us into new areas that we do not understand. Physicists examine what they produce with an eye toward novelty. Likewise, we need descriptive studies of what really happens in organizations. We cannot simply borrow theories from other fields, apply them in a laboratory, and believe that we are doing the best for organizations.

The lack of empirical work also means that we may not be looking into really critical areas. To develop a theory, or to run an experiment to test a specific theory, is to be drilling a tiny peep hole into a broad wall. It is very easy to study something irrelevant. Like Yossarian in *Catch 22*, we may be treating one wound while the person we are trying to save is bleeding from a far worse wound we haven’t looked for. Certainly anyone who has done real systems analysis knows that the initial problem statement rarely

survives the first dozen interviews. Descriptive research looks more broadly than deeply, but it helps us choose follow-up studies intelligently.

For example, as discussed earlier, we know that executives, managers, and professionals spend a great deal of time communicating. What we have done for them is to give them tools like e-mail and Facebook that are so flexible that they can use them in useful ways on their own initiative. However, given the enormous amount of organizational communication, we really need to understand it more. The communication research field can help us, but we need to do the hard work of descriptive research on information systems and communication by real people in real organizations.

A special problem with a lack of descriptive research in our field is that researchers and teachers can make flat statements that have never been tested and do so with impunity. For instance, coming from outside of programming and database areas, the author has been amused by claims in textbooks, articles, and unfortunately even submission reviews that corporate database systems are preeminently important. Yet how much time do line managers really use corporate data, and how critical is it to their work? If pushed, we have to admit that we do not know. For the more numerous staff managers and professionals in organization, the question seems even more open. Overall, our field's pronouncements about what really happens in organizations are positively medieval in their appeals to tradition. As Bertolt Brecht reminded us, "The aim of science is not to open the door to infinite wisdom but to set a limit on infinite error." Or, as Mark Twain put it, "Sacred cows make the best hamburger."<sup>1</sup>

The author wishes to close with an apology to Steven Alter (2006), whose Work System Method has many concepts similar to those discussed in this paper. It also has many areas beyond those in this paper. For example, it focuses on customers, who drive everything else. It also focuses on the environment and the general concept of work practices. The apology is due to the fact that more of his insights have not been brought into this paper do to a lack of space.

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<sup>1</sup> Richard Kempf has noted that, "Quotes are nothing but inspiration for the uninspired."

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